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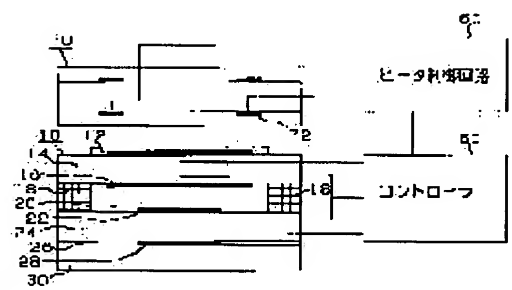
(54) METHOD AND APPARATUS FOR CONTROLLING TEMPERATURE OF TOTAL AREA OXYGEN SENSOR

(57)Abstract:
PROBLEM TO BE SOLVED: To correctly control the temperature of a sensor by impressing a current or voltage to an electromotive force cell, measuring a resistance value of the electromotive force cell with a specific timing and controlling a heater so that the resistance value becomes constant.
SOLUTION: A voltage or current is impressed to an electromotive force cell 24 held between a diffusion chamber 20 held to be a constant ambience by a pump cell 14 and an oxygen reference chamber 26 of a constant oxygen concentration. A resistance value of the electromotive force cell 24 is measured with a predetermined timing from a time point when the voltage or current is impressed in a manner not to include resistance components at an interface of a porous electrode 22, 28 and a solid electrolyte body. Accordingly, a change of interfacial resistance components due to the deterioration of the interface of the porous electrode 22, 28 and solid electrolyte body of the electromotive force cell 24, etc., included if the resistance value is measured with a low frequency current or voltage is eliminated, so that a bulk resistor component of the solid electrolyte body of the electromotive force cell 24 can be measured correctly. The resistance value correctly reflecting a temperature can be obtained in this manner.



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CLAIMS

[Claim(s)]
[Claim 1] Two cels in which the porous electrode was prepared in both sides of the oxygen ion conductivity solid electrolyte object heated at the heater for heating The pump cel which incorporates oxygen or it carries out opposite arrangement through spacing and pumps out the oxygen in said spacing for one cel around, The cel of another side is used, respectively as an electromotive force cel which produces an electrical potential difference according to the oxygen density difference of an oxygen criteria room and said spacing. The temperature of said two cels of all the field oxygen sensors that measure an oxygen density It is the temperature control approach of all the field oxygen sensors controlled using said heater for heating. The fixed current or fixed electrical potential difference for resistance measurement is impressed to said electromotive force cel. The resistance of said electromotive force cel to the appearance by which the resistance component in the interface of said porous electrode and said solid electrolyte object is not contained in this resistance The temperature control approach of all the field oxygen sensors characterized by controlling said heater so that it may measure within said current for resistance measurement, or the after [impression] predetermined time of an electrical potential difference and the resistance of said measured electromotive force cel may turn into constant value.
[Claim 2] The temperature control approach of all the field oxygen sensors of claim 1 succeedingly characterized by carrying out predetermined time impression of the fixed current or fixed electrical potential difference of reversed polarity with this current or an electrical potential difference at impression of said current for resistance measurement, or an electrical potential difference after measuring the resistance of said electromotive force cel.
[Claim 3] Two cels in which the porous electrode was prepared in both sides of the oxygen ion conductivity solid electrolyte object heated at the heater for heating The pump cel which incorporates oxygen or it carries out opposite arrangement through spacing and pumps out the oxygen in said spacing for one cel around, The cel of another side is used, respectively as an electromotive force cel which produces an electrical potential difference according to the oxygen density difference of an oxygen criteria room and said spacing. The temperature of said two cels of all the field oxygen sensors that measure an oxygen density The 1st current or electrical-potential-difference impression means of being the temperature controller of all the field oxygen sensors controlled using said heater for heating, and impressing the fixed current or fixed electrical potential difference for resistance measurement to said electromotive force cel, A resistance measurement means which measures like within said current for resistance measurement, or the after [impression] predetermined time of an electrical potential difference by which the resistance component in the interface of said porous electrode and said solid electrolyte object is not contained in this resistance in the resistance of said electromotive force cel, The 2nd current or electrical-potential-difference impression means which carries out predetermined time impression of the fixed current or electrical potential difference of reversed polarity with this current or an electrical potential difference succeedingly at impression of said current for resistance measurement, or an electrical potential difference after measuring the resistance of said electromotive force cel, a temperature control means to control said heater so that the resistance of said measured electromotive force cel turns into constant value -- since -- the temperature controller of all the field oxygen sensors characterized by changing.

[Claim 4] All the field oxygen sensors equipped with the temperature controller of claim 3.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the temperature control approach of all field oxygen sensors and temperature controller which detect the concentration of the oxygen contained in engine exhaust gas.
[0002]
[Description of the Prior Art] In order to control the air-fuel ratio of the gaseous mixture supplied to an engine to desired value and to mitigate CO in exhaust gas, NOx, and HC, an oxygen sensor is formed in an exhaust air system, and carrying out feedback control of the fuel amount of supply is known according to the oxygen density under exhaust air with an air-fuel ratio and a correlation. As an oxygen sensor used for this feedback control, lambda sensor from which an output changes in the shape of a step by the specific oxygen density (especially theoretical-air-fuel-ratio ambient atmosphere), and all the field oxygen sensors from which an output changes continuously from the Lean field to a rich field are mainly used. In order to be able to measure the oxygen density in exhaust gas continuously as mentioned above, and to raise the rate and precision of feedback control, all field oxygen sensors are used in case more nearly high-speed high precision control is required.
[0003] All field oxygen sensors carry out opposite arrangement of the two cels of an oxygen ion conductivity solid electrolyte object through spacing. It uses as a pump cel which incorporates oxygen from a perimeter or it pumps out the oxygen in spacing for one cel around. Moreover, it uses as an electromotive force cel which produces an electrical potential difference for the cel of another side according to the oxygen density difference of an oxygen criteria room and spacing, a pump cel is operated so that the output of an electromotive force cel may become fixed, and the current then passed in this pump cel is measured as an example value of the measurement oxygen ratio of concentration. The principle of operation of all these field oxygen sensors is explained in full detail in JP,62-148849,A concerning application of these people.
[0004] In order to operate all these field oxygen sensors, it is necessary to heat this pump cel and an electromotive force cel beyond predetermined temperature, and to raise the activity of an oxygen ion conductivity solid electrolyte object. For this reason, the heater for heating is attached in all field oxygen sensors near the pump cel and the electromotive force cel.
[0005]
[Problem(s) to be Solved by the Invention] Reducing further harmful gas components in current and exhaust gas, such as CO, NOx, and HC, is called for. It is necessary to measure the oxygen density in exhaust gas in removal of this harmful gas still more correctly with an oxygen sensor, and to carry out feedback control of an air-fuel ratio to it at high speed. Here, in order to raise the precision of an oxygen sensor, it is required that the temperature of an oxygen sensor should be kept constant. In order to realize constant temperature, by measuring the resistance of a heater, temperature is measured, it considers that measurement temperature is almost equal to cel temperature, and the approach of keeping the temperature of a heater constant is taken.
[0006] However, cel temperature and heater temperature stop having been in agreement, the time when the temperature of exhaust gas is low, and when the rate of flow of gas was high, it was highly precise and cel temperature was not able to be controlled by this approach.
[0007] The place which it is made in order that this invention may solve the technical problem

mentioned above, and is made into the purpose is to offer the temperature control approach of all field oxygen sensors and equipment which can keep temperature constant correctly.

[0008]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, by the temperature control approach of all the field oxygen sensors of claim 1 Two cels in which the porous electrode was prepared in both sides of the oxygen ion conductivity solid electrolyte object heated at the heater for heating The pump cel which incorporates oxygen or it carries out opposite arrangement through spacing and pumps out the oxygen in said spacing for one cel around, The cel of another side is used, respectively as an electromotive force cel which produces an electrical potential difference according to the oxygen density difference of an oxygen criteria room and said spacing. The temperature of said two cels of all the field oxygen sensors that measure an oxygen density It is the temperature control approach of all the field oxygen sensors controlled using said heater for heating. The fixed current or fixed electrical potential difference for resistance measurement is impressed to said electromotive force cel. The resistance of said electromotive force cel to the appearance by which the resistance component in the interface of said porous electrode and said solid electrolyte object is not contained in this resistance It makes to control said heater into a technical feature so that it may measure within said current for resistance measurement, or the after [impression] predetermined time of an electrical potential difference and the resistance of said measured electromotive force cel may turn into constant value.

[0009] Furthermore, in claim 2, after measuring the resistance of said electromotive force cel, with this current or an electrical potential difference, it is succeedingly characterized by carrying out predetermined time impression of the fixed current or fixed electrical potential difference of reversed polarity at impression of said current for resistance measurement, or an electrical potential difference.

[0010] In order to attain the above-mentioned purpose, in the temperature controller of all the field oxygen sensors of claim 3 Two cels in which the porous electrode was prepared in both sides of the oxygen ion conductivity solid electrolyte object heated at the heater for heating The pump cel which incorporates oxygen or it carries out opposite arrangement through spacing and pumps out the oxygen in said spacing for one cel around, The cel of another side is used, respectively as an electromotive force cel which produces an electrical potential difference according to the oxygen density difference of an oxygen criteria room and said spacing. The temperature of said two cels of all the field oxygen sensors that measure an oxygen density The 1st current or electrical-potential-difference impression means of being the temperature controller of all the field oxygen sensors controlled using said heater for heating, and impressing the fixed current or fixed electrical potential difference for resistance measurement to said electromotive force cel, A resistance measurement means which measures like within said current for resistance measurement, or the after [impression] predetermined time of an electrical potential difference by which the resistance component in the interface of said porous electrode and said solid electrolyte object is not contained in this resistance in the resistance of said electromotive force cel, The 2nd current or electrical-potential-difference impression means which carries out predetermined time impression of the fixed current or electrical potential difference of reversed polarity with this current or an electrical potential difference succeedingly at impression of said current for resistance measurement, or an electrical potential difference after measuring the resistance of said electromotive force cel, a temperature control means to control said heater so that the resistance of said measured electromotive force cel turns into constant value -- since -- it is characterized by changing.

[0011] In order to attain the above-mentioned purpose, in all the field oxygen sensors of claim 4, it is characterized by having the temperature controller of claim 3.

[0012] In invention of claim 1, since an electrical potential difference or a current is impressed to the electromotive force cel pinched by the oxygen criteria room which is spacing and the fixed oxygen density which are held by the pump cel at the fixed ambient atmosphere and resistance is measured, the oxygen density in the measurement ambient atmosphere of all field oxygen sensors can measure resistance correctly independently. Moreover, in order to measure the resistance of this electromotive force cel to predetermined timing like from the time of the resistance component in the interface of said porous electrode and said solid electrolyte object not being contained in this resistance at which

impression of an electrical potential difference and a current was started, The bulk resistor component of the solid electrolyte object of an electromotive force cel can measure correctly excluding a changed part of the resistance component in this interface by degradation of the porous electrode of an electromotive force cel, and the interface of a solid electrolyte object included when it measures with the current or electrical potential difference of low frequency. Therefore, the resistance which reflected the temperature of a cel correctly can be acquired.
[0013] In case an electrical potential difference is impressed to an electromotive force cel, in order to impress the fixed electrical potential difference or fixed current of reversed polarity to the electrical potential difference for said resistance measurement, or impression of a current to this current or an electrical potential difference in invention of claim 2 succeedingly, A reset time until it returns from the condition of not outputting the internal electromotive force value in which internal electromotive force receives effect and reflects an original oxygen density difference according to the orientation phenomenon of the oxygen ion conductivity solid electrolyte object produced when a big current is passed can be shortened. It becomes possible to resume measurement of an oxygen density after measurement of resistance for a short time.
[0014] In invention of claim 4, since an electrical potential difference or a current is impressed to the electromotive force cel pinched by the oxygen criteria room which is spacing and the fixed oxygen density which were maintained at the fixed ambient atmosphere by the pump cel and resistance is measured, the oxygen density in a measurement ambient atmosphere can measure resistance correctly independently. Moreover, since [which is measured like] the resistance component in the interface of said porous electrode and said solid electrolyte object is not contained in this resistance, the bulk resistor component of the solid-electrolyte object of an electromotive force cel can measure the resistance of this electromotive-force cel correctly excluding a changed part of the resistance component in this interface by degradation of the interface of the porous electrode of an electromotive force cel and solid electrolyte object which are included when it measures with the current or electrical potential difference of low frequency etc.
[0015]
[Embodiment of the Invention] Hereafter, the embodiment which materialized this invention is explained with reference to drawing. Drawing 1 shows all the field oxygen sensors that take like 1 operative condition as for this invention. A cel 10 is arranged in an exhaust gas system. This cel 10 is connected to the controller 50 which measures the temperature of this cel 10 while it measures the oxygen density in exhaust gas. The heater 70 controlled by the heater control circuit 60 is attached in this cel 10 through the cement made from a ceramic which is not illustrated. A heater 70 consists of ceramics, such as an alumina, as an insulating material, and the heater wiring 72 is arranged in the interior. The heater control circuit 60 impresses power to a heater 70 so that the resistance of the cel 10 measured by the controller 50 may be maintained at desired value, and it maintains the temperature of this cel 10 to the set point.
[0016] The cel 10 is constituted by carrying out the laminating of the pump cel 14, the porosity diffusion layer 18, the electromotive force cel 24, and the back up plate 30. The pump cel 14 has the porous electrodes 12 and 16 which were formed of the stabilization or partially stabilized zirconia ($ZrO2$) which is an oxygen ion conductivity solid electrolyte ingredient, and the front face and rear face were alike, respectively, and were formed mainly with platinum. Since Ip+ electrical potential difference is impressed in order to pass Ip+ current, the porous electrode 12 by the side of the front face exposed to measurement gas is referred to as an Ip+ electrode. Moreover, since Ip-electrical potential difference is impressed in order to pass Ip current, the porous electrode 14 by the side of a rear face is referred to as an Ip-electrode.
[0017] It has the porous electrodes 22 and 28 in which it was similarly formed in of stabilization or partially stabilized zirconia ($ZrO2$), and the front face and rear face also looked the electromotive force cel 24 like [porous electrodes], respectively, and it was formed mainly with platinum. Since Vs+ electrical potential difference arises, the porous electrode 28 which referred to as a Vs-electrode since Vs-electrical potential difference of the electromotive force Vs of the electromotive force cel 24 produced the porous electrode 18 arranged in the diffusion room 20 side, and was arranged in the criteria oxyecoia room 26 side is referred to as a Vs+ electrode. In addition, the criteria oxygen of the criteria oxyecoia room 26 is generated by carrying out the pumping of the fixed oxygen to a porous

electrode 28 from a porous electrode 22. Between the pump cel 14 and the electromotive force cel 24, the diffusion room 20 surrounded by the porosity diffusion layer 18 is formed. That is, this diffusion room 20 is opened for free passage with the measurement gas ambient atmosphere through the porosity diffusion layer 18. In addition, although the porosity diffusion layer 18 which is filled up with the porosity matter and changes is used in this embodiment, it is also possible to instead arrange a stoma.

[0018] Here, the oxygen according to the difference of the oxygen density of measurement gas and the oxygen density of the diffusion room 20 spreads and goes to the diffusion room 20 side through the porosity diffusion layer 18. Here, when the ambient atmosphere in the diffusion room 20 is maintained at theoretical air fuel ratio, between the Vs+ electrode 28 of the electromotive force cel 24, and the Vs-electrode 22, the potential of about 0.45 v occurs between the criteria oxyecoia rooms 26 where the oxygen density is mostly kept constant. For this reason, a controller 50 is adjusting the current Ip passed in the pump cel 14 so that the electromotive force Vs of the above-mentioned electromotive force cel potential 24 may be set to 0.45v, and measures the oxygen density in measurement gas based on the amount Ip of pump cel currents for maintaining the ambient atmosphere in the diffusion room 20 at theoretical air fuel ratio, and maintaining at this theoretical air fuel ratio.

[0019] Then, control action is described with reference to drawing 2 which shows the configuration of a controller 50. The controller 50 is performing actuation which measures an oxygen density by the cel 10, and actuation which measures temperature by measuring the bulk resistor of the electromotive force cel 24 of a cel 10. Here, oxygen density measurement is explained first.

[0020] even if Ip current on which +4V are impressed to one input terminal, the input terminal of another side is connected to the VCENT point, and an operational amplifier OP2 flows through the pump cel 14 in an output terminal changes -- a VCENT point -- setting -- 4V -- **** -- it operates like. The PID circuit which performs PID control detects the electromotive force Vs of the electromotive force cel 24, and performs actuation which determines the current Ip of the pump cel 14 that Ip current passed through resistance R1 will maintain Vs at regularity (0.45V). Thus, the electrical potential difference which is proportional to the amount of the current Ip passed by the pump cel 14 where the electromotive force of the electromotive force cel 24 is held in a PID circuit 0.45V appears in the outgoing end of a PID circuit, and after changing into a daisy JITARU value in the A/D circuit which does not illustrate this electrical potential difference in the oxygen density detector 52, the oxygen density value which corresponds from the map currently held is searched, and it outputs to the engine-control-system side which does not illustrate this value.

[0021] Then, temperature (resistance) measurement actuation of the electromotive force cel 24 of a controller 50 is explained. An operational amplifier OP1 forms a sample hold circuit with a capacitor C1, and plays the role which maintains the electromotive force Vs of this electromotive force cel 24 in front of electrical-potential-difference impression during the electrical-potential-difference impression for the thermometry of the electromotive force cel 24, and is inputted into a PID circuit. An operational amplifier OP3 is the hold value (electromotive force Vs of the electromotive force cel 24 in front of the electrical-potential-difference impression for resistance measurement) currently held at the operational amplifier OP1, and current-Iconst for resistance measurement to the electromotive force cel 24. Difference with the potential value at the time of impressing is outputted to an A/D circuit.

[0022] A switch SW1 controls an operational amplifier OP1, i.e., sample hold circuit electrical-potential-difference hold actuation. Moreover, a switch SW2 is fixed current-Iconst for resistance measurement of the electromotive force cel 24. Current-Iconst for resistance measurement which is turned on and off and by which a switch SW3 is poured with a switch SW2 is fixed current +Iconst of reversed polarity. It turns on and off.

[0023] The electromotive force Vs of the electromotive force cel 24 is shown in drawing 3 with the timing chart of switches SW1, SW2, and SW3. A switch SW1 is turned off over the time amount T6 (about 500 microseconds) set up every predetermined interval T5, as mentioned above, and the resistance measurement of the electromotive force cel 24 is closed if . In addition, in this off time amount T6, the input value to a PID circuit is maintained by 0.45V in the sample hold circuit which consists of an operational amplifier OP1.

[0024] After a switch SW1 is turned off and time amount T1 passes, a switch SW2 turns on over time amount T3 (about 100 microseconds), and it is fixed current-Iconst for resistance measurement. It passes at the electromotive force cel 24 side. This current-Iconst A polarity is the internal electromotive force and reversed polarity which are produced in the electromotive force cel 24, and is this current-Iconst. The electrical potential difference of the both ends of the electromotive force cel 24 falls by deltaVs, as shown all over drawing.
[0025] Here, it is current-Iconst. After starting impression and time amount T2 (about 60 microseconds) passes, an A/D-conversion circuit changes the output of the operational amplifier OP3 in the time (from impression initiation to the time of 60-microsecond progress) concerned into a daisy JITARU value from an analog value, and outputs it to heater control circuit side 60. The heater control circuit 60 controls the energization to a heater 70 so that this measured value, i.e., the value correlated with the bulk resistance of the electromotive force cel 24, turns into desired value. Substantially, this control functions as keeping the temperature of the oxygen sensor component 10 exact to target temperature (800-degreeC) by raising an electrical potential difference, and lowering an electrical potential difference, when lower than desired value, when the bulk resistance of the electromotive force cel 24 is higher than desired value.
[0026] In addition, it is current-Iconst here. The value at the time of 60-microsecond progress is measured from impression initiation, because the resistance component in the interface of said porous electrode and said solid electrolyte object is not contained in the measured resistance. This is because the value containing a changed part of the resistance component in this interface by degradation of the interface of the porous electrodes 22 and 28 of the electromotive force cel 24 and a solid electrolyte object etc. is detected, so it becomes impossible for measurement to carry out correctly by part for this change if it measures with the current and electrical potential difference of low frequency. Conversely, if it says, the resistance which includes degradation by changing the time amount of this measurement will be measured, and it becomes possible to use for degradation detection.
[0027] And it crosses to time amount T3 almost equal to the time amount which turned on the switch SW3 and turned on the switch SW2 by progress of time amount T3 while the switch SW2 was turned off, and is the above-mentioned current-Iconst for resistance measurement. Fixed current +Iconst of reversed polarity It is impressed by the electromotive force cel 24 side. This is for shortening a reset time until it returns to a normal condition from the condition which does not output the internal electromotive force value in which internal electromotive force receives effect and reflects an original oxygen density difference according to the orientation phenomenon of the oxygen ion conductivity solid electrolyte object which constitutes the electromotive force cel 24, and resuming measurement of an oxygen density after measurement of resistance for a short time.
[0028] The reset time to the electromotive force of the normal considered to be the orientation phenomenon of this oxygen ion conductivity solid electrolyte object is explained with reference to drawing 4 . Drawing 4 (A) is the above-mentioned current-Iconst for resistance measurement. A 4.88mA corresponding current is impressed to the electromotive force cel 24 in the shape of a pulse. Change of the electromotive force Vs of the electromotive force cel at the time of stopping this current after that is shown. Drawing 4 (B) The above-mentioned current-Iconst After impressing a 4.88mA corresponding current in the shape of a pulse, -Iconst of this current Current +Iconst of reversed polarity When it impresses to the electromotive force cel 24 in the shape of a pulse, change of the electromotive force Vs of the electromotive force cel at the time of impressing in the shape of alternation is shown. As shown in drawing 4 (A), 16 msecs are needed for the case of having added the 4.88mA current only once in the shape of a pulse, by return. On the other hand, as shown in drawing 4 (B), when a current was added in the shape of alternation, it was able to return by 0.5msec. Thus, in this embodiment, by adding a current in the shape of alternation, it resumes, and measurement of the oxygen density using the electromotive force cel 24 is obtained, and is required for a short time.
[0029] This fixed current +Iconst After progress of time amount T3 for impression, after a switch SW3 becomes off, to the timing to which time amount T four passed, a switch SW1 turns on, the electromotive force Vs of the electromotive force cel 24 is again applied to a PID circuit through an operational amplifier OP1, and measurement of an oxygen density is resumed. And the switch SW1

after progress of an interval T5 turns off, and the resistance of the electromotive force cel 24 is measured again.
[0030] In this embodiment, the temperature of a cel 10 is measured by measuring the resistance of the electromotive force cel 24 instead of the pump cel 14. This operation is explained with reference to the graph of drawing 5 . Drawing 5 (A) is a graph at the time of impressing alternating current to the electromotive force cel 24 side, and measuring resistance, and drawing 5 (B) is a graph at the time of impressing alternating current to the pump cel 14 side, and measuring resistance. Along the axis of ordinate, the heater voltage which is equivalent to an axis of abscissa in the measured resistance again at cel 10 temperature is taken all over drawing. O the value at the time of measuring by 20Hz (low frequency) in A/F23 (Lean condition) ambient atmosphere here - The value at the time of ** measuring the value at the time of delta measuring the value at the time of measuring by 1kHz (RF) in A/F23 (Lean condition) ambient atmosphere by 20Hz (low frequency) in the ambient atmosphere of theoretical air fuel ratio by 1kHz (RF) in the ambient atmosphere of theoretical air fuel ratio is shown.
[0031] In the graph of drawing 5 (A) equivalent to this embodiment, it turns out that the resistance measured in the ambient atmosphere of theoretical air fuel ratio and the resistance measured in lean atmosphere are almost equal, and does not call at an oxygen criteria room, but can measure resistance correctly. On the other hand, in the graph of drawing 5 (B), it turns out that the resistance measured in the ambient atmosphere of theoretical air fuel ratio differs from the resistance measured in lean atmosphere, and resistance cannot measure correctly by the oxygen criteria room. When this impresses a current to the electromotive force cel 24 (refer to drawing 1), since this electromotive force cel 24 is pinched by the diffusion room 20 currently fixed to the ambient atmosphere of theoretical air fuel ratio, and the oxygen criteria room 26 which is a fixed oxygen density, it is always fixed. [of the oxygen density of the both sides of this electromotive force cel] On the other hand, it is because the pump cel 14 is pinched by the measurement gas by which the oxygen density is changing, and the diffusion room 20 currently fixed to the ambient atmosphere of theoretical air fuel ratio and the oxygen density difference of the both sides of a pump cel is always changed by the oxygen density in measurement gas.
[0032]
[Effect] Since an electrical potential difference or a current is impressed to the electromotive force cel pinched by the oxygen criteria room which is spacing and the fixed oxygen density which are the ambient atmosphere of theoretical air fuel ratio with the temperature control approach of all the field oxygen sensors of claims 1 and 4, and equipment and resistance is measured as described above, the oxygen density in a measurement ambient atmosphere can measure resistance correctly independently. moreover, in order to measure the resistance of this electromotive force cel so that the resistance component of the interface of a porous electrode and a solid electrolyte object may not be contained, be alike a changed part of resistance by degradation of the porous electrode of an electromotive force cel, and the interface of a solid electrolyte object included when it measures with the current and electrical potential difference of low frequency -- it is not influenced but the temperature of a sensor component can be measured correctly.
[0033] In claim 2 or invention of 3, in case the electrical potential difference or current for resistance measurement is impressed to an electromotive force cel In order to impress the electrical potential difference or current of reversed polarity to the electrical potential difference for said resistance measurement, or impression of a current with the electrical potential difference for these resistance measurement, or a current succeedingly, A reset time until it returns to a normal condition from the condition which does not output the internal electromotive force value in which internal electromotive force receives effect and reflects an original oxygen density difference according to the orientation phenomenon of an oxygen ion conductivity solid electrolyte object can be shortened, and it becomes possible to resume measurement of an oxygen density after measurement of resistance for a short time.

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* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the explanatory view showing all the field oxygen sensor configurations that take like 1 operative condition as for this invention.
[Drawing 2] It is the circuit diagram of the controller shown in drawing 1 .
[Drawing 3] It is the timing chart of switches SW1, SW2, and SW3.
[Drawing 4] Drawing 4 (A) shows the electromotive force cel electromotive force Vs at the time of impressing the current for resistance measurement to an electromotive force cel once in the shape of a pulse, and drawing 4 (B) shows the electromotive force cel electromotive force Vs at the time of impressing a current in the shape of alternation.
[Drawing 5] Drawing 5 (A) is the graph which impressed alternating current to the electromotive force cel, and measured resistance, and drawing 5 (B) is the graph which impressed alternating current to the pump cel and measured resistance.
[Description of Notations]
10 Cel
14 Pump Cel
20 Diffusion Room
24 Electromotive Force Cel
50 Controller
60 Heater Control Circuit
70 Heater
Vs Electromotive force cel electrical potential difference
Ip Pump cel current

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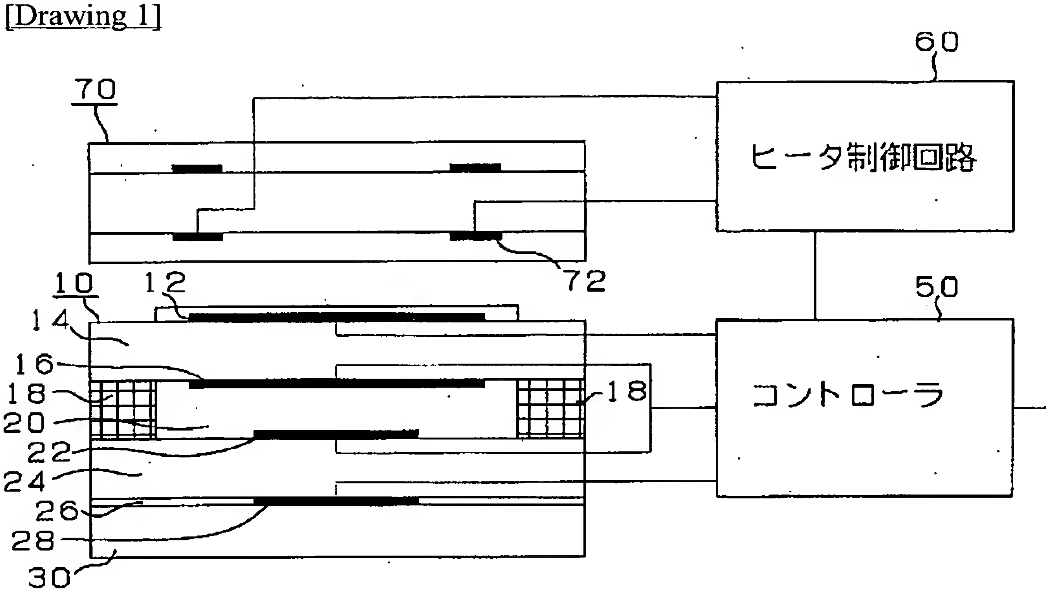
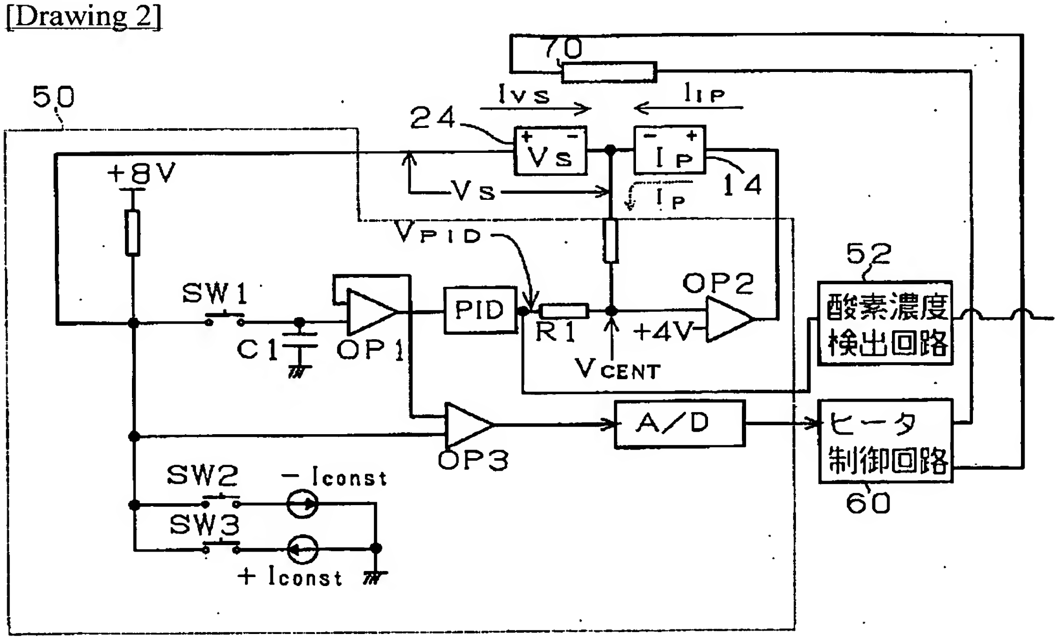
DRAWINGS

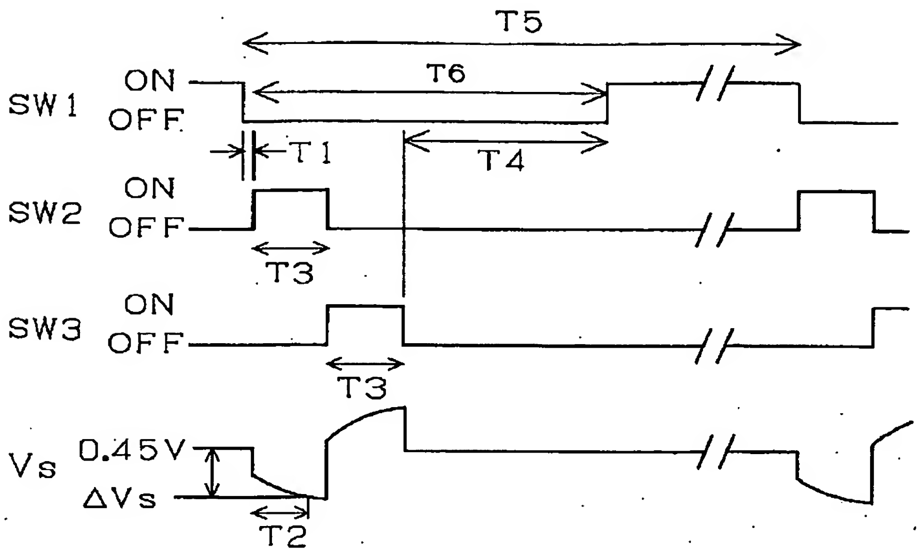
[Drawing 1]



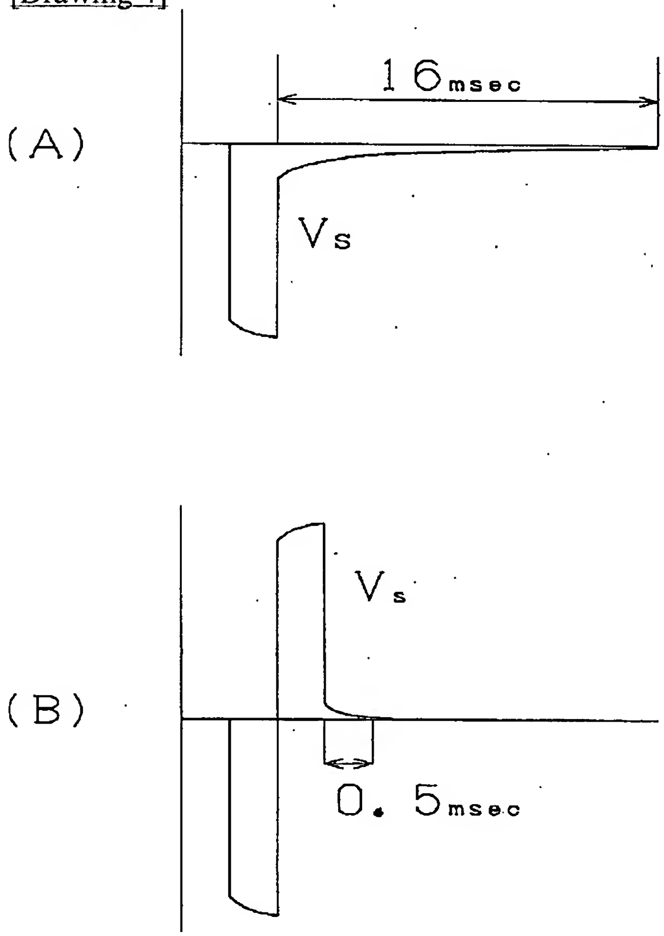
[Drawing 2]



[Drawing 3]

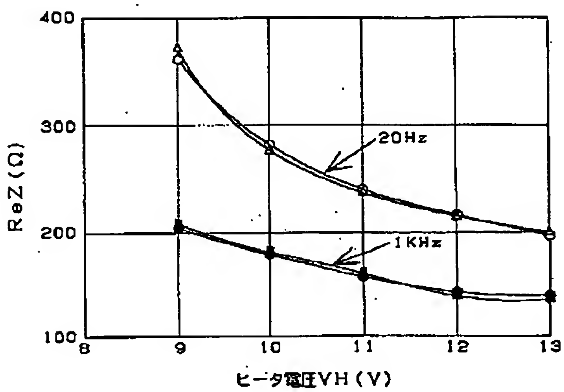


[Drawing 4]



[Drawing 5]

(A)



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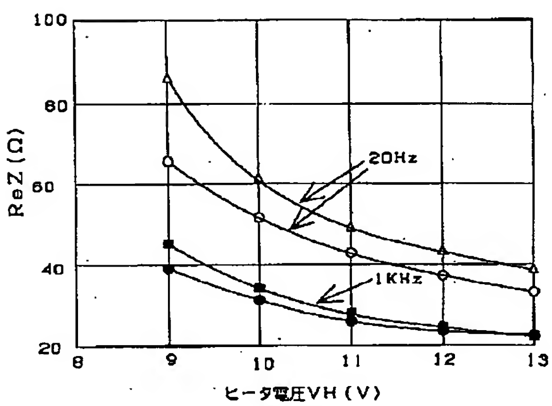

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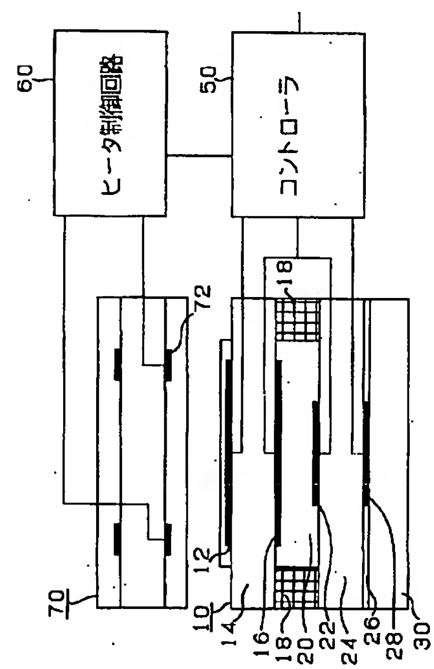
最終頁に続く

(54)【発明の名称】　全領域酸素センサの温度制御方法及び装置

(57)【要約】
【課題】　温度を正確に一定に保ち得る全領域酸素センサの温度制御方法及び装置を提供する。
【解決手段】　一定の雰囲気である拡散室２０と一定酸素濃度である酸素基準室２６とに挟まれた起電力セル２４に一定電流ＩCONST を印加して抵抗値を測定するため、酸素センサ素子１０の測定定雰囲気中の酸素濃度とは無関係に、抵抗値を正確に測定することができる。また、該起電力セル２４の抵抗値を、電流の印加を開始した時点から所定タイミングＴ２にて測定するため、直流によって測定した際に含まれる起電力セル２４の多孔質電極２２、２４の劣化等による抵抗の変化分を含まず、正確に測定できる



【特許請求の範囲】

【請求項１】　加熱用ヒータによって加熱される酸素イオン伝導性固体電解質体の両面に多孔質電極が設けられた２つのセルを、間隔を介して対向配設し、一方のセルを前記間隔内の酸素を周囲にくみ出すもしくは酸素をくみ込むポンプセル、他方のセルを酸素基準室と前記間隔との酸素濃度差によって電圧を生じる起電力セルとしてそれぞれ使用し、酸素濃度を測定する全領域酸素センサの、前記２つのセルの温度を、前記加熱用ヒータを用いて制御する全領域酸素センサの温度制御方法であって、
前記起電力セルに抵抗値測定用の一定の電流もしくは電圧を印加し、
前記起電力セルの抵抗値を、該抵抗値に前記多孔質電極と前記固体電解質体の界面における抵抗成分が含まれない様に、前記抵抗値測定用電流もしくは電圧の印加後所定時間以内に測定し、
測定した前記起電力セルの抵抗値が一定値となるように、前記ヒータを制御することを特徴とする全領域酸素センサの温度制御方法。

【請求項２】　前記起電力セルの抵抗値を測定した後に、前記抵抗値測定用電流もしくは電圧の印加に引き続いて該電流もしくは電圧とは逆極性の、一定の電流もしくは電圧を所定時間印加することを特徴とする請求項１の全領域酸素センサの温度制御方法。

【請求項３】　加熱用ヒータによって加熱される酸素イオン伝導性固体電解質体の両面に多孔質電極が設けられた２つのセルを、間隔を介して対向配設し、一方のセルを前記間隔内の酸素を周囲にくみ出すもしくは酸素をくみ込むポンプセル、他方のセルを酸素基準室と前記間隔との酸素濃度差によって電圧を生じる起電力セルとしてそれぞれ使用し、酸素濃度を測定する全領域酸素センサの、前記２つのセルの温度を、前記加熱用ヒータを用いて制御する全領域酸素センサの温度制御装置であって、
前記起電力セルに抵抗値測定用の一定の電流もしくは電圧を印加する第１の電流もしくは電圧印加手段と、
前記起電力セルの抵抗値を、該抵抗値に前記多孔質電極と前記固体電解質体の界面における抵抗成分が含まれない様に、前記抵抗値測定用電流もしくは電圧の印加後所定時間以内に測定を行う抵抗値測定手段と、
前記起電力セルの抵抗値を測定した後、前記抵抗値測定用電流もしくは電圧の印加に引き続いて該電流もしくは電圧とは逆極性の一定電流もしくは電圧を所定時間印加する第２の電流もしくは電圧印加手段と、測定した前記起電力セルの抵抗値が一定値となるように、前記ヒータを制御する温度制御手段と、から成ることを特徴とする全領域酸素センサの温度制御装置。

【請求項４】　請求項３の温度制御装置を備えた全領域酸素センサ。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、エンジンの排気ガス中に含まれる酸素の濃度を検出する全領域酸素センサの温度制御方法及び温度制御装置に関するものである。

【０００２】

【従来の技術】エンジンに供給する混合気の空燃比を目標値に制御し、排気ガス中のＣＯ、ＮＯx 、ＨＣを軽減するために、排気系に酸素センサを設け、空燃比と相関関係を持つ排気中の酸素濃度に応じて、燃料供給量をフィードバック制御することが知られている。このフィードバック制御に用いられる酸素センサとしては、特定の酸素濃度（特に理論空燃比雰囲気）で出力がステップ状に変化するλセンサと、リーン領域からリッチ領域まで連続的に出力が変化する全領域酸素センサとが主に用いられている。全領域酸素センサは、上述したように排気ガス中の酸素濃度を連続的に測定でき、フィードバック制御の速度及び精度を向上させ得るため、より高速な高精度制御が要求される際に用いられている。

【０００３】全領域酸素センサは、酸素イオン伝導性固体電解質体の２つのセルを間隔を介して対向配設し、一方のセルを間隔内の酸素を周囲にくみ出すもしくは周囲から酸素をくみ込むポンプセルとして用い、また、他方のセルを酸素基準室と間隔との酸素濃度差によって電圧を生じる起電力セルとして用い、起電力セルの出力が一定になるようにポンプセルを動作させ、その時に該ポンプセルに流す電流を、測定酸素濃度比例値として測定する。この全領域酸素センサの動作原理は、本出願人の出願に係る特開昭６２－１４８８４９号中に詳述されている。

【０００４】この全領域酸素センサを動作させるためには、該ポンプセル及び起電力セルを所定温度以上に加熱し、酸素イオン伝導性固体電解質体の活性を高める必要がある。このため、全領域酸素センサには、加熱用のヒータがポンプセル及び起電力セルの近傍に取り付けられている。

【０００５】

【発明が解決しようとする課題】現在、排気ガス中のＣＯ、ＮＯｘ、ＨＣ等の有害ガス成分を更に低減することが求められている。この有害ガスの除去には、酸素センサにて排気ガス中の酸素濃度を更に正確に測定し、空燃比のフィードバック制御を高速で行う必要がある。ここで、酸素センサの精度を高めるためには、酸素センサの温度を一定に保つことが要求される。一定温度を実現するために、ヒータの抵抗値を測定することにより、温度を測定し、測定温度をセル温度とほぼ等しいと見なして、ヒータの温度を一定に保つ方法が取られている。

【０００６】しかしながら、この方法では、排気ガスの温度が低いときや、ガスの流速が高いときには、セル温度とヒータ温度が一致しなくなり、高精度でセル温度を制御することができなかった。

【０００７】本発明は、上述した課題を解決するために

なされたものであり、その目的とするところは、温度を正確に一定に保ち得る全領域酸素センサの温度制御方法及び装置を提供することにある。

【０００８】

【課題を解決するための手段】上記の目的を達成するため、請求項１の全領域酸素センサの温度制御方法では、加熱用ヒータによって加熱される酸素イオン伝導性固体電解質体の両面に多孔質電極が設けられた２つのセルを、間隔を介して対向配設し、一方のセルを前記間隔内の酸素を周囲にくみ出すもしくは酸素をくみ込むポンプセル、他方のセルを酸素基準室と前記間隔との酸素濃度差によって電圧を生じる起電力セルとしてそれぞれ使用し、酸素濃度を測定する全領域酸素センサの、前記２つのセルの温度を、前記加熱用ヒータを用いて制御する全領域酸素センサの温度制御方法であって、前記起電力セルに抵抗値測定用の一定の電流もしくは電圧を印加し、前記起電力セルの抵抗値を、該抵抗値に前記多孔質電極と前記固体電解質体の界面における抵抗成分が含まれない様に、前記抵抗値測定用電流もしくは電圧の印加後所定時間以内に測定し、測定した前記起電力セルの抵抗値が一定値となるように、前記ヒータを制御することを技術的特徴とする。

【０００９】更に、請求項２では、前記起電力セルの抵抗値を測定した後に、前記抵抗値測定用電流もしくは電圧の印加に引き続いて該電流もしくは電圧とは逆極性の、一定の電流もしくは電圧を所定時間印加することを特徴とする。

【００１０】上記の目的を達成するため、請求項３の全領域酸素センサの温度制御装置では、　加熱用ヒータによって加熱される酸素イオン伝導性固体電解質体の両面に多孔質電極が設けられた２つのセルを、間隔を介して対向配設し、一方のセルを前記間隔内の酸素を周囲にくみ出すもしくは酸素をくみ込むポンプセル、他方のセルを酸素基準室と前記間隔との酸素濃度差によって電圧を生じる起電力セルとしてそれぞれ使用し、酸素濃度を測定する全領域酸素センサの、前記２つのセルの温度を、前記加熱用ヒータを用いて制御する全領域酸素センサの温度制御装置であって、前記起電力セルに抵抗値測定用の一定の電流もしくは電圧を印加する第１の電流もしくは電圧印加手段と、前記起電力セルの抵抗値を、該抵抗値に前記多孔質電極と前記固体電解質体の界面における抵抗成分が含まれない様に、前記抵抗値測定用電流もしくは電圧の印加後所定時間以内に測定を行う抵抗値測定手段と、前記起電力セルの抵抗値を測定した後、前記抵抗値測定用電流もしくは電圧の印加に引き続いて該電流もしくは電圧とは逆極性の一定電流もしくは電圧を所定時間印加する第２の電流もしくは電圧印加手段と、測定した前記起電力セルの抵抗値が一定値となるように、前記ヒータを制御する温度制御手段と、から成ることを特徴とする。

【００１１】上記の目的を達成するため、請求項４の全領域酸素センサでは請求項３の温度制御装置を備えたことを特徴とする。

【００１２】請求項１の発明では、ポンプセルにより一定雰囲気に保持されている間隔と一定酸素濃度である酸素基準室とに挟まれた起電力セルに電圧又は電流を印加して抵抗値を測定するため、全領域酸素センサの測定雰囲気中の酸素濃度とは無関係に、抵抗値を正確に測定することができる。また、該起電力セルの抵抗値を、該抵抗値に前記多孔質電極と前記固体電解質体の界面における抵抗成分が含まれない様に、電圧及び電流の印加を開始した時点から所定タイミングにて測定するため、低周波の電流又は電圧によって測定した際に含まれる起電力セルの多孔質電極と固体電解質体の界面の劣化等による該界面における抵抗成分の変化分を含まず、起電力セルの固体電解質体のバルク抵抗成分が正確に測定できる。従ってセルの温度を正確に反映した抵抗値を得ることができる。

【００１３】請求項２の発明では、起電力セルに電圧を印加する際に、前記抵抗測定用の電圧又は電流の印加に引き続いて該電流又は電圧に対して逆極性の一定の電圧又は電流を印加するため、大きな電流を流した場合に生じる酸素イオン伝導性固体電解質体の配向現象によって内部起電力が影響を受け本来の酸素濃度差を反映する内部起電力値を出力しない状態から復帰するまでの復帰時間を短縮でき、抵抗値の測定後に短時間で酸素濃度の測定を再開することが可能となる。

【００１４】請求項４の発明では、ポンプセルにより一定雰囲気に保たれた間隔と一定酸素濃度である酸素基準室とに挟まれた起電力セルに電圧又は電流を印加して抵抗値を測定するため、測定雰囲気中の酸素濃度とは無関係に、抵抗値を正確に測定することができる。また、該起電力セルの抵抗値を、該抵抗値に前記多孔質電極と前記固体電解質体の界面における抵抗成分が含まれない様に測定するため、低周波の電流もしくは電圧によって測定した際に含まれる起電力セルの多孔質電極と固体電解質体との界面の劣化等による該界面における抵抗成分の変化分を含まず、起電力セルの固体電解質体のバルク抵抗成分が正確に測定できる。

【００１５】

【発明の実施の形態】以下、本発明を具体化した実施態様について図を参照して説明する。図１は、本発明の一実施態様に係る全領域酸素センサを示している。セル１０は排気ガス系に配設される。該セル１０は、排気ガス中の酸素濃度を測定すると共に該セル１０の温度を測定するコントローラ５０に接続されている。このセル１０には、ヒータ制御回路６０にて制御されるヒータ７０が、図示しないセラミック製接合剤を介して取り付けられている。ヒータ７０は、絶縁材料としてアルミナ等のセラミックから成りその内部にヒータ配線７２が配設さ

れている。ヒータ制御回路６０は、コントローラ５０により測定されるセル１０の抵抗値を、目標値に保つようヒータ７０へ電力を印加し、該セル１０の温度を設定値に維持する。

【００１６】セル１０は、ポンプセル１４と、多孔質拡散層１８と、起電力セル２４と、補強板３０とを積層することにより構成されている。ポンプセル１４は、酸素イオン伝導性固体電解質材料である安定化または部分安定化ジルコニア（ZrO_2）により形成され、その表面と裏面のそれぞれに主として白金で形成された多孔質電極１２、１６を有している。測定ガスに晒される表面側の多孔質電極１２は、Ｉｐ＋電流を流すためにＩｐ＋電圧が印加されるためＩｐ＋電極として参照する。また、裏面側の多孔質電極１４は、Ｉｐ電流を流すためにＩｐ－電圧が印加されるためＩｐ－電極として参照する。

【００１７】起電力セル２４も同様に安定化または部分安定化ジルコニア（ZrO_2）により形成され、その表面と裏面のそれぞれに主として白金で形成された多孔質電極２２、２８を有している。拡散室２０側に配設された多孔質電極１８は、起電力セル２４の起電力ＶｓのＶｓ－電圧が生じるためＶｓ－電極として参照し、また、基準酸素室２６側に配設された多孔質電極２８は、Ｖｓ＋電圧が生じるためＶｓ＋電極として参照する。なお、基準酸素室２６の基準酸素は多孔質電極２２から一定酸素を多孔質電極２８にポンピングする事により生成する。ポンプセル１４と起電力セル２４との間には、多孔質拡散層１８により包囲された拡散室２０が形成されている。即ち、該拡散室２０は、多孔質拡散層１８を介して測定ガス雰囲気と連通されている。なお、本実施態様では、多孔質物質を充填して成る多孔質拡散層１８を用いるが、この代わりに小孔を配設することも可能である。

【００１８】ここで、測定ガスの酸素濃度と拡散室２０の酸素濃度との差に応じた酸素が、拡散室２０側に多孔質拡散層１８を介して拡散して行く。ここで、拡散室２０内の雰囲気が理論空燃比に保たれるとき、ほぼ酸素濃度が一定に保たれている基準酸素室２６との間で、起電力セル２４のＶｓ＋電極２８とＶｓ－電極２２との間には、約０．４５ｖの電位が発生する。このため、コントローラ５０は、ポンプセル１４に流す電流Ｉｐを、上記起電力セル電位２４の起電力Ｖｓが０．４５ｖとなるように調整することで、拡散室２０内の雰囲気を理論空燃比に保ち、この理論空燃比に保つためのポンプセル電流量Ｉｐに基づき、測定ガス中の酸素濃度を測定する。

【００１９】引き続き、コントローラ５０の構成を示す図２を参照して制御動作について述べる。コントローラ５０は、セル１０により酸素濃度を測定する動作と、セル１０の起電力セル２４のバルク抵抗を測定することで温度を測定する動作とを行っている。ここでは、まず、酸素濃度測定について説明する。

【００２０】オペアンプＯＰ２は、一方の入力端子に＋４Ｖが印加され、他方の入力端子はVCENT点に接続されており、出力端子にて、ポンプセル１４を介して流れるＩｐ電流が変化しても、VCENT点に於いて４Ｖに保っように動作する。ＰＩＤ制御を行うＰＩＤ回路は起電力セル２４の起電力Ｖｓを検出し、抵抗Ｒ１を介して流すＩｐ電流によってＶｓを一定（０．４５Ｖ）に保つようにポンプセル１４の電流Ｉｐを決定する動作を行う。このように、ＰＩＤ回路にて起電力セル２４の起電力が０．４５Ｖに保持された状態で、ポンプセル１４に流される電流Ｉｐの量に比例する電圧がＰＩＤ回路の出力端に現れ、この電圧を酸素濃度検出回路５２で、図示しないＡ／Ｄ回路にてデェジタル値に変換した後、保持しているマップから対応する酸素濃度値を検索し、この値を図示しないエンジン制御装置側へ出力する。

【００２１】引き続き、コントローラ５０の起電力セル２４の温度（抵抗）測定動作について説明する。オペアンプＯＰ１は、コンデンサＣ１と共にサンプルホールド回路を形成し、起電力セル２４の温度測定のための電圧印加中において電圧印加直前の、該起電力セル２４の起電力Ｖｓを保ちＰＩＤ回路に入力する役割を果たす。オペアンプＯＰ３は、オペアンプＯＰ１に保持されているホールド値（抵抗値測定用電圧印加直前の起電力セル２４の起電力Ｖｓ）と、起電力セル２４に抵抗値測定用の電流－Ｉconst を印加した際の電位値との差分をＡ／Ｄ回路へ出力する。

【００２２】スイッチＳＷ１は、オペアンプＯＰ１、即ち、サンプルホールド回路電圧ホールド動作を制御する。また、スイッチＳＷ２は、起電力セル２４の抵抗値測定用の一定電流－Ｉconst をオン・オフし、スイッチＳＷ３は、スイッチＳＷ２にて流される抵抗値測定用の電流－Ｉconstとは逆極性の一定電流＋Ｉconst をオン・オフする。

【００２３】スイッチＳＷ１、ＳＷ２、ＳＷ３のタイミングチャートと共に起電力セル２４の起電力Ｖｓを図３に示す。スイッチＳＷ１は、上述したように所定のインターバルＴ５毎に設定された時間Ｔ６（約５００μｓ）に渡りオフし、起電力セル２４の抵抗測定を可能ならしめる。なお、このオフ時間Ｔ６においては、オペアンプＯＰ１から成るサンプルホールド回路にて、ＰＩＤ回路への入力値は０．４５Ｖに維持される。

【００２４】スイッチＳＷ１がオフされてから時間Ｔ１が経過した後、スイッチＳＷ２が時間Ｔ３（約１００μｓ）に渡りオンし、抵抗値測定用の一定電流－Ｉconst が起電力セル２４側に流される。この電流－Ｉconst の極性は、起電力セル２４に生じる内部起電力と逆極性であって、この電流－Ｉconst によって起電力セル２４の両端の電圧が、図中に示すようにΔＶｓ分低下する。

【００２５】ここで、電流－Ｉconst の印加を開始した後、時間Ｔ２（約６０μｓ）が経過してから、当該時点

（印加開始から６０μｓ経過時）でのオペアンプＯＰ３の出力を、Ａ／Ｄ変換回路がアナログ値からデェジタル値に変換してヒータ制御回路側６０へ出力する。ヒータ制御回路６０は、この測定された値、即ち、起電力セル２４のバルク抵抗値と相関する値が目標値となるようにヒータ７０への通電を制御する。この制御は実質的に、起電力セル２４のバルク抵抗値が目標値よりも高いときには、電圧を高め、また、目標値よりも低いときには、電圧を下げることにより、酸素センサ素子１０の温度を正確に目標温度（８００°Ｃ）に保つよう機能する。

【００２６】なお、ここで、電流－Ｉconst の印加開始から６０μｓ経過時の値を測定するのは、測定された抵抗値に前記多孔質電極と前記固体電解質体の界面における抵抗成分が含まれないようにするためである。これは、低周波の電流や電圧によって測定を行うと起電力セル２４の多孔質電極２２、２８と固体電解質体との界面の劣化等による該界面における抵抗成分の変化分を含む値が検出されるため、この変化分によって正確に測定が行い得なくなるからである。逆に言えばこの測定の時間を変化させることにより劣化を含めた抵抗を測定し、劣化検出に用いることが可能となる。

【００２７】そして、時間Ｔ３の経過により、スイッチＳＷ２をオフすると同時に、スイッチＳＷ３をオンし、スイッチＳＷ２をオンした時間とほぼ等しい時間Ｔ３に渡り、抵抗値測定用の上記電流－Ｉconst とは逆極性の一定電流＋Ｉconst を起電力セル２４側に印加する。これは、起電力セル２４を構成する酸素イオン伝導性固体電解質体の配向現象によって内部起電力が影響を受け本来の酸素濃度差を反映する内部起電力値を出力しない状態から、正常な状態に復帰するまでの復帰時間を短縮させ、抵抗値の測定後に酸素濃度の測定を短時間で再開し得るようにするためである。

【００２８】この酸素イオン伝導性固体電解質体の配向現象と考えられる正規の起電力までの復帰時間について、図４を参照して説明する。図４（Ａ）は、抵抗値測定用の上記電流－Ｉconst に相当する４．８８ｍＡの電流をパルス状に起電力セル２４へ印加し、その後該電流を止めた場合の起電力セルの起電力Ｖｓの変化を示し、図４（Ｂ）は、上記電流－Ｉconst に相当する４．８８ｍＡの電流をパルス状に印加した後、該電流の－Ｉconst と逆極性の電流＋Ｉconst をパルス状に起電力セル２４へ印加した場合、即ち、交番状に印加した場合の起電力セルの起電力Ｖｓの変化を示している。図４（Ａ）に示すように４．８８ｍＡの電流をパルス状に１回加えただけの場合には、復帰までに１６msec必要となった。これに対して、図４（Ｂ）に示すように電流を交番状に加えた場合は、０．５msecで復帰することができた。この様に、本実施態様では、電流を交番状に加えることで起電力セル２４を用いる酸素濃度の測定を短時間で再開し得るようにしいてる。

【００２９】この一定電流＋Ｉconst の印加のための時間Ｔ３の経過後、スイッチＳＷ３がオフとなった後、時間Ｔ４が経過したタイミングで、スイッチＳＷ１がオンし、起電力セル２４の起電力Ｖｓが再び、オペアンプＯＰ１を介してＰＩＤ回路に加えられ、酸素濃度の測定が再開される。そして、インターバルＴ５の経過後スイッチＳＷ１がオフし、再び起電力セル２４の抵抗値を測定する。

【００３０】本実施態様では、ポンプセル１４ではなく起電力セル２４の抵抗値を測定することでセル１０の温度を測定している。この作用について図５のグラフを参照して説明する。図５（Ａ）は、起電力セル２４側に交流電流を印加して抵抗値を測定した際のグラフであり、図５（Ｂ）は、ポンプセル１４側に交流電流を印加して抵抗値を測定した際のグラフである。図中で縦軸には測定された抵抗値を、また、横軸にはセル１０温度に相当するヒータ電圧を取っている。ここで、○は、Ａ／Ｆ２３（リーン状態）雰囲気中にて２０Hz（低周波）で測定した際の値を、●は、Ａ／Ｆ２３（リーン状態）雰囲気中にて１KHz（高周波）で測定した際の値を、Δは、理論空燃比の雰囲気中にて２０Hz（低周波）で測定した際の値を、■は、理論空燃比の雰囲気中にて１KHz（高周波）で測定した際の値を示している。

【００３１】本実施態様に相当する図５（Ａ）のグラフでは、理論空燃比の雰囲気中で測定された抵抗値と、リーン雰囲気中で測定された抵抗値とがほぼ等しく、酸素基準室によらず正確に抵抗値が測定できることが分かる。これに対して、図５（Ｂ）のグラフでは、理論空燃比の雰囲気中で測定された抵抗値と、リーン雰囲気中で測定された抵抗値とが異なり、酸素基準室により抵抗値が正確に測定できないことが分かる。これは、起電力セル２４（図１参照）に電流を印加した際に、該起電力セル２４は、理論空燃比の雰囲気に固定されている拡散室２０と、一定酸素濃度である酸素基準室２６とに挟まれているので該起電力セルの両側の酸素濃度は常に一定である。これに対して、ポンプセル１４は、酸素濃度の変化している測定ガスと、理論空燃比の雰囲気に固定されている拡散室２０とに挟まれ、ポンプセルの両側の酸素濃度差は測定ガス中の酸素濃度によって常に変動するからである。

【００３２】

【効果】以上記述したように請求項１及び４の全領域酸素センサの温度制御方法及び装置では、理論空燃比の雰囲気である間隔と一定酸素濃度である酸素基準室とに挟まれた起電力セルに電圧又は電流を印加して抵抗値を測定するため、測定雰囲気中の酸素濃度とは無関係に、抵抗値を正確に測定することができる。また、該起電力セルの抵抗値を、多孔質電極と固体電解質体の界面の抵抗成分が含まれないように測定するため、低周波の電流や電圧によって測定した場合に含まれる起電力セルの多孔

質電極と固体電解質体の界面の劣化等による抵抗の変化分によ影響を受けず、正確にセンサ素子の温度を測定できる。

【００３３】請求項２又は３の発明では、起電力セルに抵抗測定用の電圧もしくは電流を印加する際に、前記抵抗測定用の電圧もしくは電流の印加に引き続いて該抵抗測定用の電圧もしくは電流とは逆極性の電圧もしくは電流を印加するため、酸素イオン伝導性固体電解質体の配向現象によって内部起電力が影響を受け本来の酸素濃度差を反映する内部起電力値を出力しない状態から、正常な状態に復帰するまでの復帰時間を短縮でき、抵抗値の測定後に短時間で酸素濃度の測定を再開することが可能となる。

【図面の簡単な説明】

【図１】本発明の一実施態様に係る全領域酸素センサ構成を示す説明図である。

【図２】図１に示すコントローラの回路図である。

【図３】スイッチＳＷ１、ＳＷ２、ＳＷ３のタイミングチャートである。＊

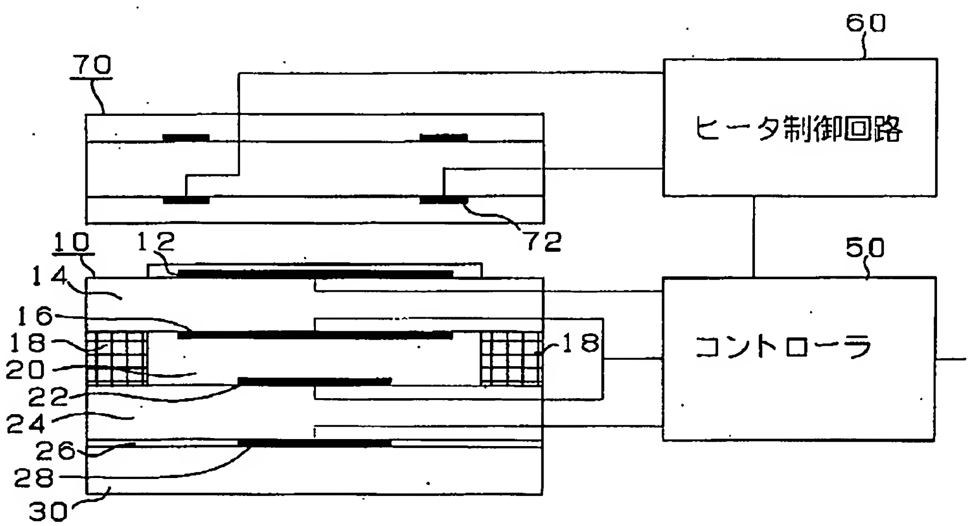
＊【図４】図４（Ａ）は、抵抗値測定用電流をパルス状に一回起電力セルへ印加した際の起電力セル起電力Ｖｓを示し、図４（Ｂ）は、電流を交番状に印加した際の起電力セル起電力Ｖｓを示している。

【図５】図５（Ａ）は、起電力セルに交流電流を印加して抵抗値を測定したグラフであり、図５（Ｂ）は、ポンプセルに交流電流を印加して抵抗値を測定したグラフである。

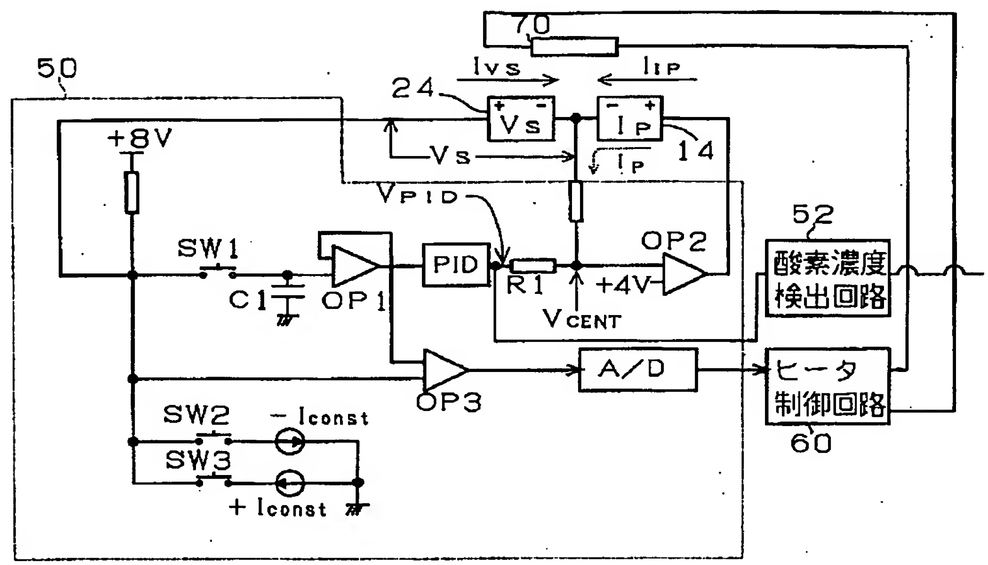
【符号の説明】

１０　セル
１４　ポンプセル
２０　拡散室
２４　起電力セル
５０　コントローラ
６０　ヒータ制御回路
７０　ヒータ
Ｖｓ　起電力セル電圧
Ｉｐ　ポンプセル電流

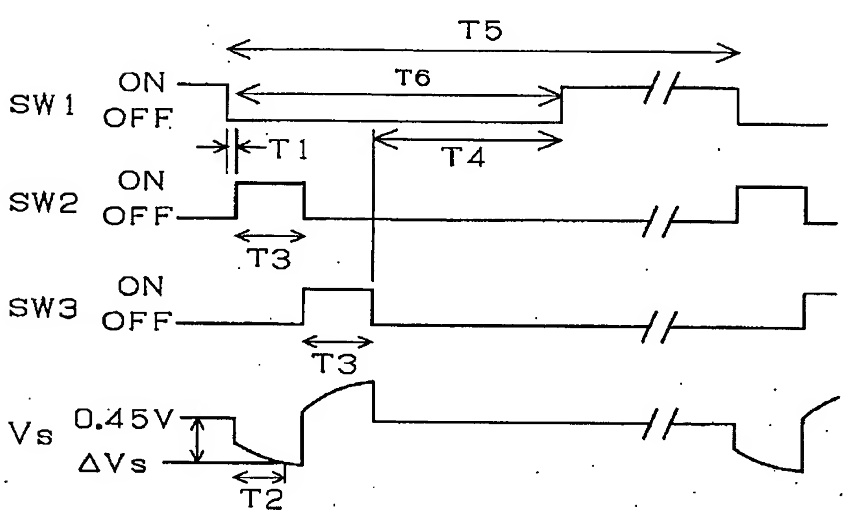
【図１】



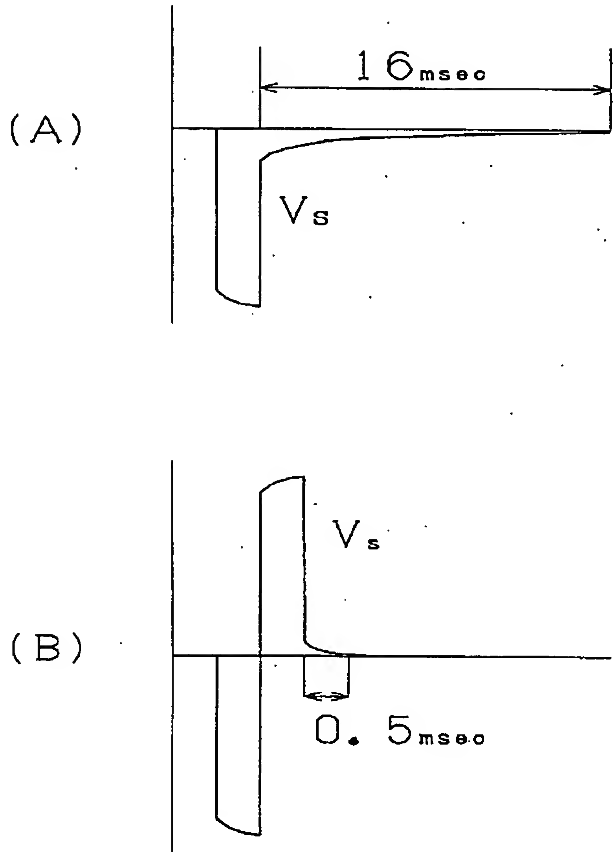
【図２】


70
50
24
Ivs
IIP
Vs
IP
14
+8V
VPID
52
SW1
PID
R1
OP2
+4V
酸素濃度
検出回路
C1
OP1
VCENT
A/D
OP3
ヒータ
制御回路
60
SW2
－Iconst
SW3
＋Iconst

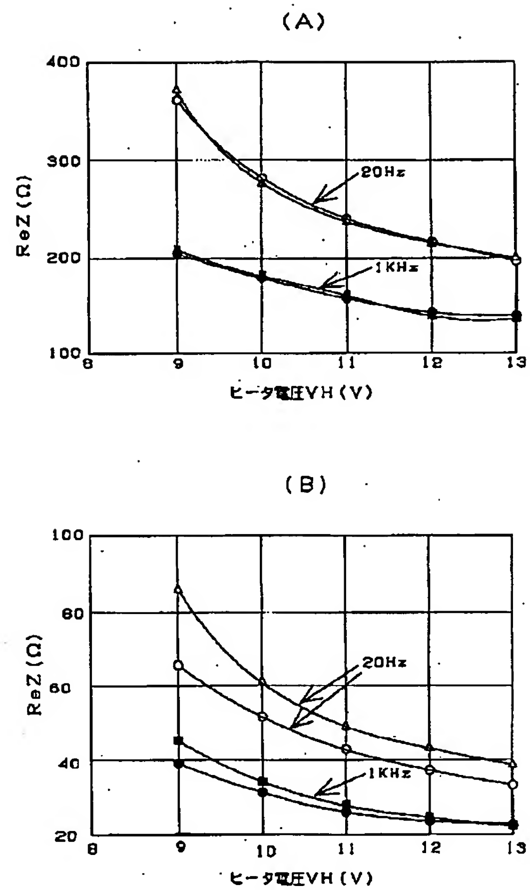
【図３】


T5
T6
SW1
ON
OFF
T1
T4
SW2
ON
OFF
T3
SW3
ON
OFF
T3
Vs
0.45V
ΔVs
T2

【図４】



【図５】



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